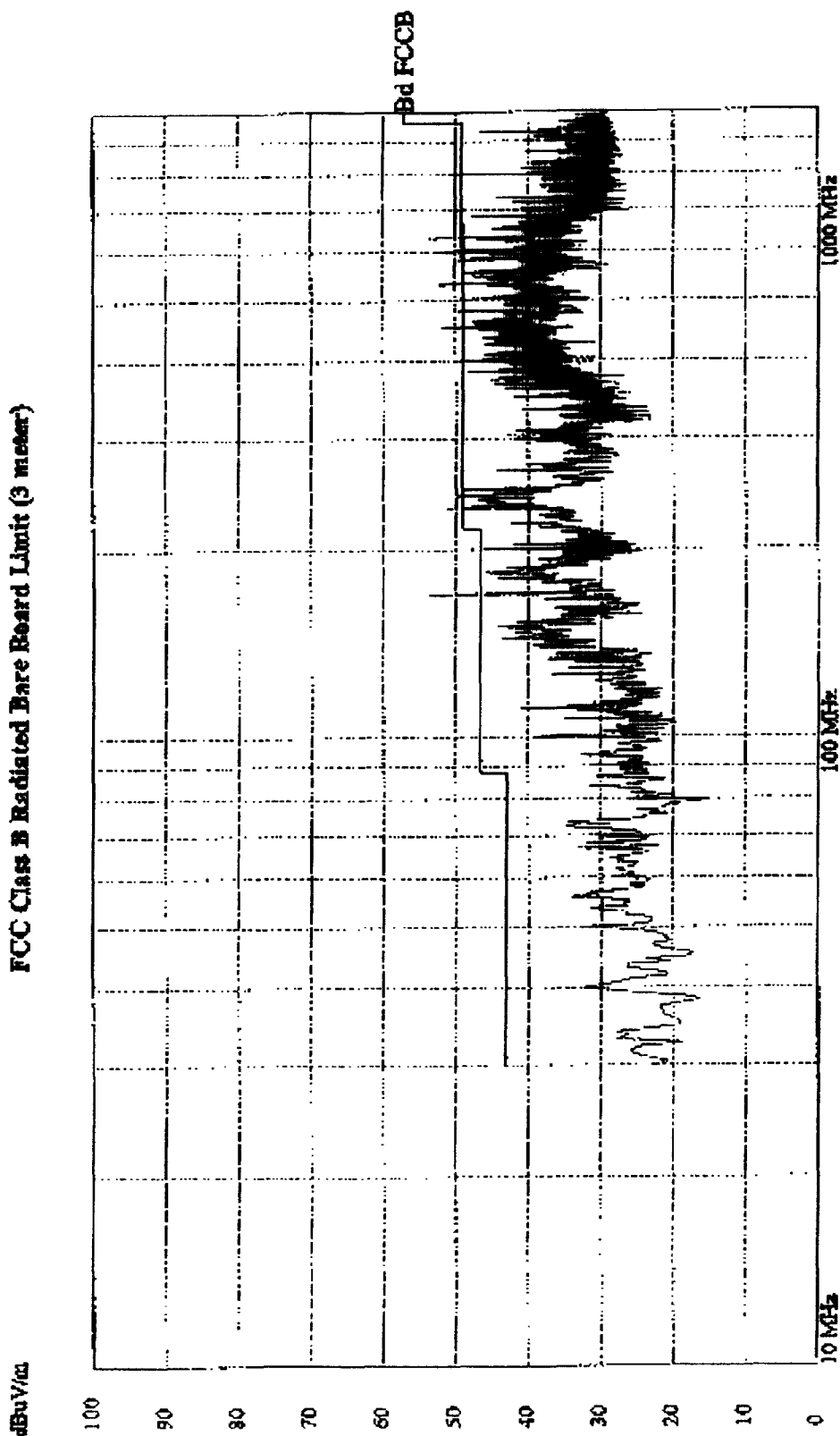


Ver. 4.6, April 1996

Peak data.

Northwest EMC
EUT Name: Venus II S/N: 091396
Manufacturer: Local Corp.
Date/Job Number: 09-13-1996 14:46:45 INTE0669
Tested By: Greg Klemm, Newberg
Comments: 200MHz CPU, VGA (add-in card). Full sound, all peripherals.
Run #2. Same as #1, but with side covers removed, monitor on left side.



Ver. 4.6, April 1996

Peak data margin sort.

Northwest EMC

EUT Name: Venus II S/N: 091396

Manufacturer: Intel Corp.

Date/Job Number: 09-13-1996 14:47:40 INTE0669

Tested By: Greg Kiemel, Newberg

Comments: 200MHz CPU, VGA (add-in card). Full sound, all peripherals.
Run #2. Same as #1, but with side covers removed, monitor on left side.

FCC Class B Radiated Bare Board Limit (3 meter)

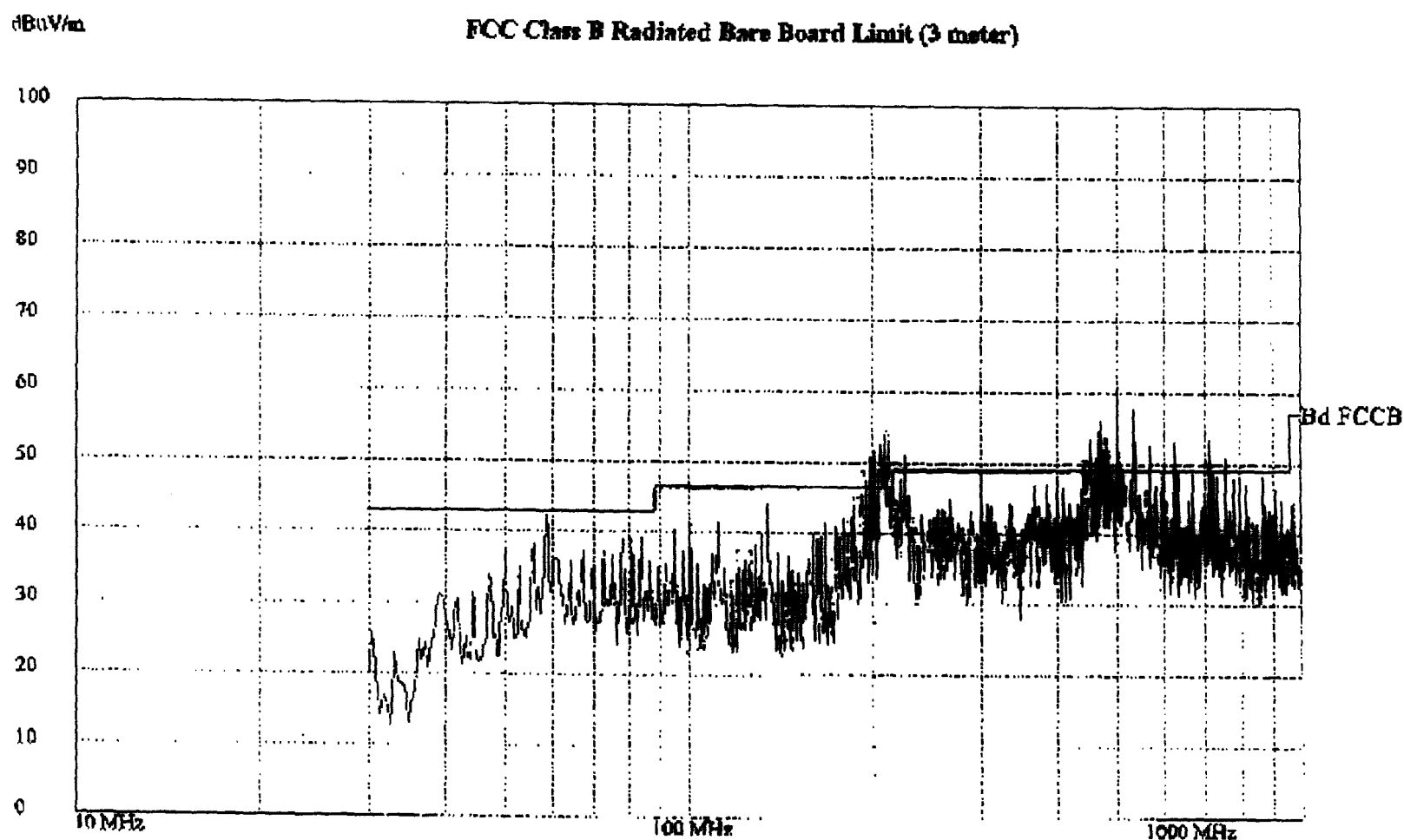
Frequency (MHz)	Ampl. (dBuV)	AntFact (dB)	Ant. Pol.	Prcamp (dB)	Cab.+Atten Loss	Chamber (dB)	Adjusted (dBuV/m)	Spec (dBuV/m)	Margin (dB)
170.000	61.2	16.1	Hor.	31.5	1.9	6.0	53.7	46.5	-7.2 - video ?
631.000	58.5	19.4	Ver.	31.4	4.2	3.0	53.7	49.0	-4.7 - clock
599.942	57.8	18.9	Ver.	31.3	4.1	3.0	52.5	49.0	-3.5 - clock
531.091	58.2	18.2	Ver.	31.2	4.0	3.0	52.2	49.0	-3.2 - clock
452.115	59.7	17.0	Ver.	31.3	3.6	3.0	52.0	49.0	-3.0 - ?
233.412	64.2	11.7	Hor.	31.3	2.3	4.2	51.1	49.0	-2.1 - clock
799.000	53.2	21.7	Ver.	31.9	5.0	3.0	51.0	49.0	-2.0 - clock
602.979	55.6	18.9	Ver.	31.3	4.1	3.0	50.3	49.0	-1.3 - clock
602.979	55.6	18.9	Ver.	31.3	4.1	3.0	50.3	49.0	-1.3
601.000	55.2	18.9	Ver.	31.3	4.1	3.0	49.9	49.0	-0.9
480.465	56.5	17.6	Ver.	31.2	3.8	3.0	49.7	49.0	-0.7
581.716	55.1	18.8	Ver.	31.3	4.1	3.0	49.7	49.0	-0.7
200.188	52.7	17.6	Hor.	31.4	2.1	5.0	46.0	46.5	0.5
183.563	53.2	16.6	Hor.	31.4	2.0	5.6	46.0	46.5	0.5
180.063	50.3	16.3	Hor.	31.4	1.9	7.0	44.1	46.5	2.4
150.750	56.5	15.3	Hor.	31.5	1.9	1.8	44.0	46.5	2.5
144.625	56.1	15.0	Hor.	31.5	1.9	2.0	43.5	46.5	3.0
186.625	50.8	16.8	Hor.	31.4	2.0	4.7	42.9	46.5	3.6
149.875	55.0	15.3	Hor.	31.5	1.9	2.0	42.7	46.5	3.8
243.337	62.3	12.2	Hor.	31.3	2.4	4.0	49.6	49.0	-0.6

Signature

Ver. 4.7 Nov. 1996

Peak data.

Northwest EMC Cumberland
EUT Name: ~~Anchorage~~ in Toshiba S/N: 03051997
Manufacturer: Intel Corp.
Date/Job Number: 03-05-1997 08:33:02 INTE0914
Tested By: Wayne Seto, Newberg
Comments: 200 MHz CPU with MMX (tm) Technology, 1280x1024@75 Hz Video, All Peripherals, No LAN
Run #3, Cover Off Test



Ver. 4.7 Nov. 1996

Peak data margin sort.

Northwest EMC

Cumberland

EUT Name: ~~Amherst~~ in Toshiba S/N: 03051997

Manufacturer: Intel Corp.

Date/Job Number: 03-05-1997 08:33:57 INTE0914

Tested By: Wayne Seto, Newberg

Comments: 200 MHz CPU with MMX (tm) Technology, 1280x1024@75 Hz Video, All Peripherals, No LAN
Run #3, Cover Off Test

FCC Class B Radiated Bare Board Limit (3 meter)

Frequency (MHz)	Ampl. (dBuV)	AntFact (dB)	Ant. Pol.	Preamplifier (dB)	Cable + Attenuator Loss	Chamber (dB)	Adjusted (dBuV/m)	Spec (dBuV/m)	Margin (dB)	
500.715	67.9	18.1	Ver.	32.2	4.0	3.0	60.8	49.0	-11.8	Onboard LAN
534.128	64.9	18.2	Ver.	32.3	4.0	3.0	57.8	49.0	-8.8	CPU CLOCK
211.137	68.5	11.5	Hor.	32.3	2.2	4.7	54.6	46.5	-8.1	?
208.100	67.8	11.6	Hor.	32.3	2.2	4.8	54.1	46.5	-7.6	?
470.340	64.0	17.4	Ver.	32.1	3.8	3.0	56.1	49.0	-7.1	?
462.240	63.0	17.2	Ver.	32.1	3.7	3.0	54.8	49.0	-5.8	?
467.302	62.9	17.3	Ver.	32.1	3.7	3.0	54.8	49.0	-5.8	CPU CLOCK
200.625	59.2	17.6	Hor.	32.3	2.1	5.0	51.6	46.5	-5.1	CPU CLOCK
478.440	61.7	17.6	Ver.	32.1	3.8	3.0	54.0	49.0	-5.0	?
454.140	61.9	17.1	Ver.	32.1	3.6	3.0	53.5	49.0	-4.5	?
197.563	59.2	17.5	Hor.	32.3	2.1	4.5	51.0	46.5	-4.5	?
710.000	57.1	21.5	Ver.	32.8	4.6	3.0	53.4	49.0	-4.4	?
621.000	59.4	19.2	Ver.	32.5	4.2	3.0	53.3	49.0	-4.3	?
567.541	59.3	18.6	Ver.	32.3	4.1	3.0	52.7	49.0	-3.7	?
473.377	60.3	17.5	Ver.	32.1	3.8	3.0	52.5	49.0	-3.5	
484.515	59.8	17.7	Ver.	32.2	3.9	3.0	52.2	49.0	-3.2	
503.753	58.9	18.1	Ver.	32.2	4.0	3.0	51.8	49.0	-2.8	
203.250	56.7	17.7	Hor.	32.3	2.1	4.9	49.1	46.5	-2.6	
192.315	58.2	17.1	Hor.	32.3	2.0	4.0	49.0	46.5	-2.5	
200.000	62.5	11.7	Hor.	32.3	2.1	5.0	49.0	46.5	-2.5	

Signature

Temperature: 71F 47% Humidity



Video Card Emissions Profile Analysis

January 31, 1997

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4. CONCLUSION.....	3

1. Introduction

Data was collected by Mike Haines, Senior EMC Technician, on 10 add-in video cards to determine their emissions profiles with the cover of a PC removed to determine their impact on qualification tests of CPU boards. Testing was performed on January 29 at Northwest EMC in Hillsboro, Oregon with the results reported by Mike Haines in a document on January 30. This document takes a look at the results in more detail.

2. Applicable Rules

The following portion of the FCC Rules details the requirements for testing CPU boards. As noted in §15.32(a)(1), a cover off test is required. In order for the CPU board to pass this test, all other parts of the system must pass as well. In order to allow the CPU board to pass, it is necessary to identify peripheral devices and other components which will not fail with the cover removed.

§15.32 Test procedures for CPU boards and computer power supplies. - Power supplies and CPU boards used with personal computers and for which separate authorizations are required to be obtained shall be tested as follows:

(a) CPU boards shall be tested as follows:

(1) Testing for radiated emissions shall be performed with the CPU board installed in a typical enclosure but with the enclosure's cover removed so that the internal circuitry is exposed at the top and on at least two sides. Additional components, including a power supply, peripheral devices, and subassemblies, shall be added, as needed, to result in a complete personal computer system. If the oscillator and the microprocessor circuits are contained on separate circuit boards, both boards, typical of the combination that would normally be employed, must be used in the test. Testing shall be in accordance with the procedures specified in §15.31 of this part. Under these test conditions, the system under test shall not exceed the radiated emission limits specified in §15.109 by more than 3 dB;

(2) Unless the test in paragraph (a)(1) of this section demonstrates compliance with the limits in §15.109, a second test shall be performed using the same configuration described in paragraph (a)(1) but with the cover installed on the enclosure. Testing shall be in accordance with the procedures specified in §15.31. Under these test conditions, the system under test shall not exceed the radiated emission limits specified in §15.109; and

(3) The test demonstrating compliance with the AC power line conducted limits specified in §15.107 shall be performed in accordance with the procedures specified in §15.31 using a enclosure, peripherals, power supply and subassemblies that are typical of the type with which the CPU board under test would normally be employed.

As can be seen in §15.32(a)(1) above, all internal components in a PC chassis will be exposed when performing this test. As video cards have been a particular concern during cover on testing, it was felt that tests were needed with the cover off on a variety of cards.

3. Data Analysis

The data collected at Northwest EMC and reported by Mike Haines on January 30 was entered into an Excel spreadsheet for analysis. Only the 20 worst signals were reported by the lab for each run. As a result, some signals noted without a video card are not reported on the tests with video cards installed as they did not make the top 20 list. The results are shown in Appendix A. All margins shown in the data and reported in this text are with respect to the published FCC Class B limit (§15.109 of the FCC Rules). A system is allowed to fail by no more than 3 dB with the cover removed. Thus, any signals shown in the data with a failure margin (positive margin) of less than 3 dB are not considered failures in this cover off test.

The data on page 1 of Appendix A is from the two runs taken with no video card installed. The right hand column shows the spread between the two runs at each frequency. The worst case deviation is 1.8 dB. Many readings were less than 1 dB apart. This shows excellent repeatability in the measurement process. The data shows the motherboard to fail by 15.6 dB at 200.188 MHz. This is 12.6 dB higher than would be allowed in a cover off test to the requirements in §15.32(a)(1) of the FCC Rules.

The following table shows the worst case signal for each video card tested. The margins noted are for frequencies which were not detected from the motherboard when a video card was not installed. Examination of the data in Appendix A will show that some motherboard signals were enhanced by installing a video card, but these are not noted in this table.

Video Card	Frequency	Margin (dB)
ATI Mach64 PCI	555.391 MHz	12.6 dB
Vision968 S3 PCI	301.250 MHz	8.4 dB
Cirrus PCI	251.637 MHz	8.7 dB
Diamond Viper PCI	237.462 MHz	18.7 dB
STB Powergraph64 PCI	533.116 MHz	7.2 dB
STB Powergraph32 PCI	198.000 and 632.000 MHz	6.6 dB
GXE PCI	501.728 and 601.966 MHz	11.4 dB
Matrox MGA PCI	226.325 MHz	11.6 dB
ATI Mach64 GT PCI	201.063 MHz	15.5 dB
Orchid ProDesigner II ISA	836.000 MHz	23.7 dB

As can be seen, the STB Powergraph32 PCI Video controller came the closest to be usable for cover off testing of CPU boards, but even it was too noisy by 3.6 dB.

4. Conclusion

The sample of video cards used for this test shows that many commonly available video cards on the market will generate emissions in excess of that allowed during a cover off test performed to qualify a CPU board to the requirements in §15.32(a)(1) of the FCC Rules. The rules allow no relief for emissions shown to come from a peripheral device. Thus, based on the sample of video cards taken for this survey, it is not possible to qualify a CPU board (motherboard) to the new requirements in the FCC Rules. A revision to the rules to allow subtracting emissions shown to come from components other than the CPU board or a deletion of §15.32(a)(1) of the Rules is needed. As video cards (and other peripheral devices and internal components) are not required to comply with this cover off test, it is not reasonable to expect that video card manufacturers will incur the additional cost of development and production to bring their products into compliance with this requirement solely to allow CPU board manufacturers to successfully test their products.



Video Card Emissions Profile
Test Results

January 31, 1997
Appendix A

200 MHz Pentium Pro, Cover off, No Video Card

Frequency MHz	Run 1 dB(uV/m)	Margin to FCC B Limit (dB)	Run 2 dB(uV/m)	Margin to FCC B Limit (dB)	Run to Run Delta
192.750	43.1	-0.4			
200.000	44.2	0.7	46.0	2.5	-1.8
200.188	58.6	15.1	59.1	15.6	-0.5
233.412	46.1	0.1	45.1	-0.9	1.0
240.500	45.4	-0.6			
250.625			47.1	1.1	
266.825	45.6	-0.4	46.1	0.1	-0.5
336.688	47.7	1.7	46.4	0.4	1.3
400.477	48.4	2.4	47.8	1.8	0.6
433.889	50.3	4.3	49.8	3.8	0.5
440.977	48.3	2.3	48.2	2.2	0.1
467.302	46.0	0.0	46.2	0.2	-0.2
521.978	52.6	6.6	52.0	6.0	0.6
530.078	48.6	2.6	48.6	2.6	0.0
541.216	46.4	0.4	45.1	-0.9	1.3
561.466	48.4	2.4	48.7	2.7	-0.3
566.529	50.2	4.2	49.8	3.8	0.4
599.942	48.0	2.0	47.0	1.0	1.0
721.000			45.0	-1.0	
733.000	46.4	0.4	46.0	0.0	0.4
799.000	58.1	12.1	58.5	12.5	-0.4
933.000			44.7	-1.3	



Video Card Emissions Profile
Test Results

January 31, 1997
Appendix A

200 MHz Pentium Pro, Cover off, ATI Mach64 PCI
Video Card

Frequency MHz	No Video Run 1 dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
195.813			48.2	4.7
200.000	44.2	0.7		
200.188	58.6	15.1	56.4	12.9
203.038			50.1	6.6
209.113			48.2	4.7
233.412	46.1	0.1		
234.425			50.4	4.4
240.500	45.4	-0.6		
266.825	45.6	-0.4		
336.688	47.7	1.7		
400.477	48.4	2.4		
433.889	50.3	4.3		
440.977	48.3	2.3		
454.140			53.5	7.5
467.302	46.0	0.0		
479.453			50.6	4.6
491.603			51.3	5.3
504.765			56.3	10.3
521.978	52.6	6.6		
530.078	48.6	2.6	55.7	9.7
541.216	46.4	0.4		
542.228			52.3	6.3
555.391			58.6	12.6
561.466	48.4	2.4		
566.529	50.2	4.2		
567.541			52.8	6.8
579.691			54.9	8.9
592.854			54.0	8.0
599.942	48.0	2.0		
604.000			52.4	6.4
617.000			52.6	6.6
632.000			51.7	5.7
666.000			51.2	5.2
733.000	46.4	0.4		
799.000	58.1	12.1	59.5	13.5

200 MHz Pentium Pro, Cover off, Vision968 PCI S3
Video Card

Frequency MHz	No Video Run 1 dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
200.000	44.2	0.7		
200.188	58.6	15.1	55.5	12.0
233.412	46.1	0.1		
240.500	45.4	-0.6		
266.825	45.6	-0.4		
301.250			54.4	8.4
333.651			51.9	5.9
336.688	47.7	1.7	49.7	3.7
367.064			49.4	3.4
400.477	48.4	2.4		
433.889	50.3	4.3	51.4	5.4
440.977	48.3	2.3		
467.302	46.0	0.0		
481.478			50.5	4.5
521.978	52.6	6.6	50.7	4.7
530.078	48.6	2.6		
533.116			51.8	5.8
541.216	46.4	0.4		
561.466	48.4	2.4		
566.529	50.2	4.2	50.2	4.2
599.942	48.0	2.0	50.3	4.3
616.000			49.6	3.6
625.000			52.4	6.4
632.000			54.2	8.2
645.000			50.1	4.1
661.000			49.3	3.3
674.000			49.2	3.2
699.000			50.2	4.2
722.000			52.1	6.1
733.000	46.4	0.4		
799.000	58.1	12.1	59.3	13.3

200 MHz Pentium Pro, Cover off, Cirrus PCI Video
Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
200.000	44.2	0.7		
200.188	58.6	15.1	53.7	11.2
233.412	46.1	0.1	51.2	5.2
240.500	45.4	-0.6		
248.600			52.7	6.7
251.637			54.7	8.7
258.725			49.5	3.5
260.750			49.9	3.9
266.825	45.6	-0.4	51.5	5.5
336.688	47.7	1.7		
400.477	48.4	2.4		
433.889	50.3	4.3	51.7	5.7
440.977	48.3	2.3		
467.302	46.0	0.0		
502.740			52.5	6.5
521.978	52.6	6.6		
530.078	48.6	2.6		
531.091			55.4	9.4
541.216	46.4	0.4		
553.366			53.3	7.3
560.453			48.7	2.7
561.466	48.4	2.4		
566.529	50.2	4.2		
599.942	48.0	2.0	52.3	6.3
616.000			49.0	3.0
625.000			51.7	5.7
632.000			53.3	7.3
666.000			50.0	4.0
699.000			48.5	2.5
721.000			48.8	2.8
733.000	46.4	0.4		
799.000	58.1	12.1	59.6	13.6



200 MHz Pentium Pro, Cover off, Diamond Viper PCI
Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
157.313			49.0	5.5
192.750	43.1	-0.4		
195.375			49.8	7.3
200.000	44.2	0.7		
200.188	58.6	15.1	56.0	12.5
201.938			48.4	4.9
209.113			57.8	14.3
233.412	46.1	0.1	57.1	11.1
237.462			64.7	18.7
240.500	45.4	-0.6		
261.762			55.0	9.0
266.825	45.6	-0.4	53.8	7.8
314.413			52.1	6.1
336.688	47.7	1.7		
400.477	48.4	2.4	56.1	10.1
418.702			55.5	9.5
433.889	50.3	4.3	52.5	6.5
440.977	48.3	2.3		
467.302	46.0	0.0		
521.978	52.6	6.6		
524.003			59.4	13.4
530.078	48.6	2.6		
541.216	46.4	0.4		
561.466	48.4	2.4		
566.529	50.2	4.2		
575.641			56.4	10.4
599.942	48.0	2.0	51.9	5.9
733.000	46.4	0.4		
799.000	58.1	12.1	59.7	13.7
866.000			51.2	5.2



Video Card Emissions Profile
Test Results

January 31, 1997
Appendix A

200 MHz Pentium Pro, Cover off, STB Powergraph64
PCI Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Martin to FCC B Limit (dB)
192.750	43.1	-0.4		
198.000			50.2	6.7
200.000	44.2	0.7		
200.188	58.6	15.1	53.9	10.4
203.038			50.5	7.0
233.412	46.1	0.1		
240.500	45.4	-0.6		
266.825	45.6	-0.4	48.2	2.2
336.688	47.7	1.7	48.4	2.4
400.477	48.4	2.4		
433.889	50.3	4.3	53.3	7.3
440.977	48.3	2.3		
467.302	46.0	0.0		
533.116			53.2	7.2
521.978	52.6	6.6	48.1	2.1
530.078	48.6	2.6		
541.216	46.4	0.4		
560.453			47.7	1.7
561.466	48.4	2.4		
566.529	50.2	4.2		
599.942	48.0	2.0	51.0	5.0
616.000			49.0	3.0
625.000			50.5	4.5
632.000			52.7	6.7
645.000			47.7	1.7
666.000			52.1	6.1
674.000			48.2	2.2
699.000			48.4	2.4
722.000			49.8	3.8
733.000	46.4	0.4		
799.000	58.1	12.1	57.8	11.8
866.000			48.8	2.8

200 MHz Pentium Pro, Cover off, STB Powergraph32
PCI Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Martin to FCC B Limit (dB)
53.188			43.1	3.1
166.500			46.3	2.8
192.750	43.1	-0.4		
198.000			50.1	6.6
200.000	44.2	0.7		
200.188	58.6	15.1	56.7	13.2
203.688			46.1	2.6
233.412	46.1	0.1		
240.500	45.4	-0.6		
266.825	45.6	-0.4		
336.688	47.7	1.7		
400.477	48.4	2.4		
433.889	50.3	4.3	50.7	4.7
440.977	48.3	2.3		
467.302	46.0	0.0		
521.978	52.6	6.6	52.4	6.4
530.078	48.6	2.6		
533.116			51.1	5.1
541.216	46.4	0.4		
561.466	48.4	2.4		
566.529	50.2	4.2	49.2	3.2
599.942	48.0	2.0	51.4	5.4
625.000			51.5	5.5
632.000			52.6	6.6
645.000			49.6	3.6
666.000			48.9	2.9
674.000			51.2	5.2
689.000			48.9	2.9
699.000			51.8	5.8
722.000			52.4	6.4
733.000	46.4	0.4	49.2	3.2
799.000	58.1	12.1	59.2	13.2

200 MHz Pentium Pro, Cover off, GXE PCI Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
195.375			48.5	5.0
199.750			54.6	11.1
200.000	44.2	0.7		
200.188	58.6	15.1		
233.412	46.1	0.1	51.1	5.1
240.500	45.4	-0.6		
250.625			53.0	7.0
266.825	45.6	-0.4		
301.250			56.7	10.7
336.688	47.7	1.7		
400.477	48.4	2.4		
401.489			50.8	4.8
433.889	50.3	4.3	51.7	5.7
440.977	48.3	2.3		
467.302	46.0	0.0		
479.453			50.2	4.2
501.728			57.4	11.4
504.765			52.6	6.6
521.978	52.6	6.6		
530.078	48.6	2.6		
533.116			50.7	4.7
541.216	46.4	0.4		
551.341			56.9	10.9
555.391			52.0	6.0
561.466	48.4	2.4		
566.529	50.2	4.2		
599.942	48.0	2.0		
601.000			57.1	11.1
601.966			57.4	11.4
605.000			54.1	8.1
625.000			51.6	5.6
632.000			52.6	6.6
666.000			50.3	4.3
733.000	46.4	0.4		
799.000	58.1	12.1	57.7	11.7



Video Card Emissions Profile
Test Results

January 31, 1997
Appendix A

200 MHz Pentium Pro, Cover off, Matrox MGA PCI
Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
199.750			51.5	8.0
200.000	44.2	0.7		
200.188	58.6	15.1		
201.012			49.2	5.7
201.063			48.9	5.4
226.325			57.6	11.6
233.412	46.1	0.1		
240.500	45.4	-0.6		
251.637			55.5	9.5
266.825	45.6	-0.4		
336.688	47.7	1.7		
351.876			51.9	5.9
400.477	48.4	2.4		
433.889	50.3	4.3	52.3	6.3
440.977	48.3	2.3		
467.302	46.0	0.0		
521.978	52.6	6.6	50.4	4.4
528.053			52.6	6.6
530.078	48.6	2.6		
533.116			54.5	8.5
540.203			50.7	4.7
541.216	46.4	0.4		
553.366			55.6	9.6
561.466	48.4	2.4		
566.529	50.2	4.2		
599.942	48.0	2.0	58.3	12.3
602.000			50.7	4.7
625.000			52.8	6.8
632.000			54.3	8.3
653.000			50.9	4.9
699.000			52.3	6.3
722.000			51.9	5.9
733.000	46.4	0.4		
799.000	58.1	12.1	59.3	13.3

200 MHz Pentium Pro, Cover off, ATI Mach64 GT PCI
Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
195.375			51.1	7.6
197.563			49.8	6.3
199.750			55.5	12.0
200.000	44.2	0.7		
200.188	58.6	15.1		
201.012			57.6	14.1
201.063			59.0	15.5
203.250			50.3	6.8
233.412	46.1	0.1		
240.500	45.4	-0.6		
266.825	45.6	-0.4		
333.651			52.2	6.2
336.688	47.7	1.7		
400.477	48.4	2.4		
433.889	50.3	4.3	50.3	4.3
440.977	48.3	2.3		
467.302	46.0	0.0		
521.978	52.6	6.6		
530.078	48.6	2.6	51.2	5.2
541.216	46.4	0.4		
561.466	48.4	2.4		
566.529	50.2	4.2	54.1	8.1
588.804			50.5	4.5
599.942	48.0	2.0		
602.000			57.4	11.4
602.979			57.0	11.0
616.000			52.4	6.4
625.000			55.0	9.0
632.000			55.1	9.1
699.000			52.4	6.4
722.000			50.4	4.4
733.000	46.4	0.4		
799.000	58.1	12.1	60.2	14.2



200 MHz Pentium Pro, Cover off, Orchid ProDesigner II
ISA Video Card

Frequency MHz	No video dB(uV/m)	Margin to FCC B Limit (dB)	w/ Video dB(uV/m)	Margin to FCC B Limit (dB)
192.750	43.1	-0.4		
194.938			51.3	7.8
199.750			51.8	8.3
200.000	44.2	0.7		
200.188	58.6	15.1		
202.375			51.8	8.3
204.050			50.9	7.4
204.125			46.8	3.3
207.087			46.3	2.8
215.188			49.4	5.9
227.337			51.2	5.2
233.412	46.1	0.1		
240.500	45.4	-0.6		
266.825	45.6	-0.4		
303.275			50.5	4.5
336.688	47.7	1.7	49.5	3.5
400.477	48.4	2.4		
408.577			51.1	5.1
433.889	50.3	4.3	52.2	6.2
440.977	48.3	2.3		
467.302	46.0	0.0		
479.453			48.6	2.6
521.978	52.6	6.6		
530.078	48.6	2.6	51.9	5.9
541.216	46.4	0.4	55.3	9.3
561.466	48.4	2.4		
566.529	50.2	4.2	48.4	2.4
599.942	48.0	2.0	49.1	3.1
625.000			48.3	2.3
733.000	46.4	0.4		
799.000	58.1	12.1	60.1	14.1
836.000			69.7	23.7



Add-in Video Card Emissions Profile Test Results

January 30, 1997

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1. Executive Summary

Due to a change in the FCC Rules that went into effect on August 19, 1996, by June 19, 1997 CPU board and power supply vendors must either;

1. Obtain authorization for all CPU boards and power supplies they wish to market in the U.S.; or
2. If the board has not received authorization, obtain written confirmation from each customer that he will obtain FCC authorization for the system into which he is installing the CPU board or power supply.

This document provides results showing that emissions from various video card manufacturers may prevent Intel from qualifying a CPU board even if we were to bring the motherboard into compliance. All boards tested so far failed on their own accord.

2. Introduction

The Report and Order on FCC Docket OET 95-19 which went into effect on August 19, 1996 made a number of changes to Parts 2 and 15 of the FCC Rules (47 CFR Parts 2 and 15). The major impact of these changes was to allow manufacturers of personal computers the option of self declaring compliance with the FCC rules subject to certain conditions. One of the options for this self declaration was to declare compliance based on the use of previously approved components with no test of the finished system. As motherboards and primary processor boards used in PCs (or CPU Boards as they are called in §15.3(bb) of the FCC Rules) and power supplies had not been allowed to obtain separate approvals in the past, test methods for them were created and added to the Rules in §15.32. Another significant impact is that CPU boards and power supplies sold to customers who need not conduct EMI tests on their end product must now be authorized under the FCC Rules. In order to be authorized, CPU boards must be tested as part of a complete system. This plan provides a means of identifying disc drives which will be suitable for this test process.

3. Applicable Rules

The following portion of the FCC Rules details the requirements for testing CPU boards. As noted in §15.32(a)(1), a cover off test is required. In order for the CPU board to pass this test, all other parts of the system must pass as well. In order to allow the CPU board to pass, it is necessary to identify peripheral devices and other components which will not fail with the cover removed.

§15.32 Test procedures for CPU boards and computer power supplies. - Power supplies and CPU boards used with personal computers and for which separate authorizations are required to be obtained shall be tested as follows:

(a) CPU boards shall be tested as follows:

(1) Testing for radiated emissions shall be performed with the CPU board installed in a typical enclosure but with the enclosure's cover removed so that the internal circuitry is exposed at the top and on at least two sides. Additional components, including a power supply, peripheral devices, and subassemblies, shall be added, as needed, to result in a complete personal computer system. If the oscillator and the microprocessor circuits are contained on separate circuit boards, both boards, typical of the combination that would normally be employed, must be used in the test. Testing shall be in accordance with the procedures specified in §15.31 of this part. Under these test conditions, the system under test shall not exceed the radiated emission limits specified in §15.109 by more than 3 dB;

(2) Unless the test in paragraph (a)(1) of this section demonstrates compliance with the limits in §15.109, a second test shall be performed using the same configuration described in paragraph (a)(1) but with the cover installed on the enclosure. Testing shall be in accordance with the procedures specified in §15.31. Under these test conditions, the system under test shall not exceed the radiated emission limits specified in §15.10; and

(3) The test demonstrating compliance with the AC power line conducted limits specified in §15.107 shall be performed in accordance with the procedures specified in §15.31 using a enclosure, peripherals, power supply and subassemblies that are typical of the type with which the CPU board under test would normally be employed.

4. Test Procedure

The test platform was a chassis with the cover removed. This exposed the top and 2 sides. Internal to the system was a motherboard running at 200 MHz, a Western Digital 425 MB hard drive, a Sony 1.44 MB floppy drive, and an Astec 200 watt power supply. The internal cables were tie-wrapped in place for repeatability. Attached to the system was a keyboard and mouse. A monitor was attached for boot-up and to start the test software. The monitor was then disconnected from the system and powered down.

An initial scan was done with the system operating but with the video card removed to pinpoint frequencies not related to the add-in card. This test was run a second time to determine repeatability. Then a total of 10 different video card were run all at their lowest video mode (640x480).

All tests were run using a fixed antenna height. Both horizontal and vertical polarities were measured with the worst case being presented at any given frequency.

Plots of the full frequency range of 30 to 1000 MHz are provided for each video card and the two runs with no card installed along with tabular results for specific emissions from each card. Margins shown are to FCC limits with the 3 dB allowance already included, any failure is +3 dB to FCC system limits.

5. Data Analysis/Test Results

Data collected during this process shows each card tested for the cover off test of CPU boards for compliance with §15.32(a) of the FCC Rules has noise generated above the 3 dB allowance.